KNOWLEDGE

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S SCHOOLS (part three)

DURING the 19th century the governments of the most progressive European countries realised that education must be provided for all children. They were aware that this could only be carried out effectively by the State, which must control the establishment of schools and generally be responsible for providing the means of education. Also during this century, philosophers, educationists, and teachers continued to question the ways of teaching which were practised at that time.

Friedrich Froebel (1782–1852), a German, was particularly interested in the education of young children in kindergartens, but his ideas have affected education in all schools.

Johann Friedrich Herbart (1776–1841) was both a philosopher and a practical educationist. He believed that children must be interested in a subject in order to learn about it properly, and that the main task of a teacher was to arouse interest and to keep a subject fresh and alive.

John Dewey (1859–1952), an American philosopher and educationist, believed that children must take an active part in their own education. He also believed that practical experience should come before abstract learning.

These people, among others, have had a great influence on schools and methods of teaching all over the world.

Development of education in England

As governments became more interested in education, there was conflict in many countries between the Church and State over the control of schools (see Schools: part two). This conflict occurred in Britain, but, eventually, a compromise was achieved through the Elementary Education Act of 1870, and a partnership between the Church authorities and the Government came into being, which is still the foundation of our educational system.

A botany lesson in a local park

Written work is an essential part of education

Schools today

During the 20th century, schools have steadily reflected the changes in educational thought and administration. Primary education today includes nursery schools, infant schools, and junior schools.

Nursery schools

These schools are for very young children. The teachers use methods which help the child's intelligence to develop and teach him how to control his movements. The children spend much of their time in climbing, running, jumping, and dancing, whenever possible in the open air. They are shown how to take an interest in nature and how to be kind to animals. They discover how to use words through songs and stories, and they learn how to get on with other children. Their teachers are specially trained for this work, and the parents of the children co-operate to make sure that the best possible benefit is obtained from attendance at a nursery school.

Infant schools

Infant schools today are very different from those of the early 19th century. In these schools, children between the ages of five and seven years learn the first steps in reading, writing, and using numbers. They also learn in an active way through play and experience. At times they are even free to choose their

Previous page: A nature-study lesson taking place out of doors. Later, in the classroom, a film-strip projector may be used to follow up what the children have seen.

KNOWLEDGE
NEWS
Week beginning 12th May 1963

Manchester massacre — 11 civilians killed as Hussars charge in the . . .

The charge of the Scots Greys at Waterloo (above) was much more glorious than the charge of the Hussars at St Peter's Field.

BATTLE OF 'PETERLOO'

AUGUST 17, 1819

ELEVEN people were killed and hundreds injured when troops broke up a vast public meeting in St Peter's Field, Manchester, yesterday. Men, women and children were left bleeding on the ground after a furious cavalry charge which, in ten minutes, had scattered a crowd estimated at 60,000. Many were slashed by sabres as the cavalry hacked their way through. Many more were crushed as the screaming and panic-stricken mob tried to escape.

The Radical organisers of the meeting, including Henry 'Orator' Hunt, and two women, have been taken to the New Bailey Prison in Salford. When brought to trial they may face the capital charge of high treason.

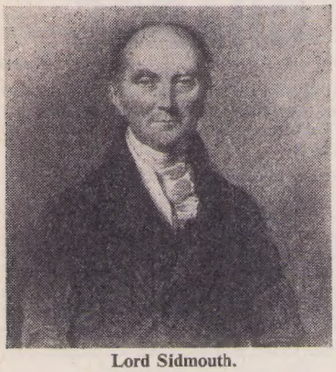
Since early morning crowds had been streaming into Manchester from outlying districts. From Oldham, Stockport, Bolton, Rochdale and other places came contingents of thousands, marching in orderly fashion in the hot sunshine, singing, chanting, and carrying banners.

The meeting had been called by the Radical Societies with the object of drawing attention to the need for Parliamentary reform and to the distressed condition of many sections of the community. On the banners were such slogans as 'No Corn Laws', 'No Taxation Without Representation', and 'Annual Parliaments'.

The main speaker was none other than Henry 'Orator' Hunt, the acknowledged Radical leader. At a quarter past one on this sunny afternoon a great cheer went up as he made his way to the speaker's rostrum. But scarcely had he begun to speak than the magistrates gave orders for his arrest. The Manchester Yeomanry moved in amongst the crowd but got hopelessly entangled and began lashing out with their sabres. From his observation post in a nearby house, William Hulton, one of the magistrates, thought the crowd was attacking the yeomanry and shouted to Colonel L'Estrange of the 15th Hussars: 'Good God, sir, do you not see how they are attacking the yeomanry? Disperse the crowd!' So the Hussars charged into the defenceless and screaming mass.

The meeting was quickly dispersed, and those who were not lying dead or injured on the ground made their way home as quickly as they could.

Tonight Manchester looks like a garrisoned town. Troops stand in the streets, shutters bar the windows. Behind the windows families mourn their dead or their injured. Waterloo was the end of Napoleon. Is 'Peterloo' the end of Radicalism?



Lord Sidmouth.

SIDMOUTH WAS AGAINST VIOLENCE

IT is now certain that the Home Office was not solidly behind the action taken at Peterloo.

Despite official communications of congratulation from the Government, it seems clear that the Home Secretary, Lord Sidmouth, was against the use of troops to break up the Radical assembly. The following instructions were sent to Manchester a fortnight ago:

'Lord Sidmouth has no doubt that you will make arrangements for obtaining evidence of what passes. But even if they should utter sedition, he is of the opinion that it will be the wisest course to abstain from any endeavour to disperse the mob. His Lordship considers that this mode of proceeding is far preferable to any attempt to disperse the assembly by force'.

Death sentence for shoplifting

A 17-year-old girl was sentenced to death for shoplifting when she appeared at Bow Street Magistrates' Court yesterday.

When the sentence was pronounced, the girl broke down and wept. The girl, Pauline Howard, had admitted stealing an expensive pair of shoes from a fashionable city store. In demanding the death sentence, prosecuting counsel stressed the inadequacies of law enforcement. Over 200 offences carried the death penalty, he said, but few were enforced. Between 1805 and 1807, no fewer than 113 persons were sentenced to death for shoplifting, but not one had been actually hanged. In this case, he said, 'let us enact and enforce the law in all its severity'.

The massacre begins – out come the sabres of the Manchester Yeomanry.

'Firm and temperate deportment' — Hunt

THE crowd at St Peter's Field seems to have heeded Henry Hunt's plea for a peaceful demonstration. There was no sign of pikes or other weapons.

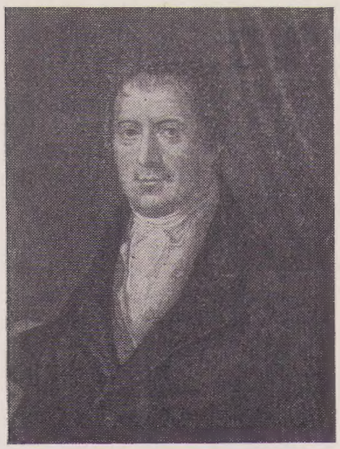
On 11th August Hunt had issued this direction to his followers:

'You will meet on Monday next, my friends, and by your steady, firm and temperate deportment, you will convince all your enemies that you feel that you have an important and an imperious public duty to perform. . . .

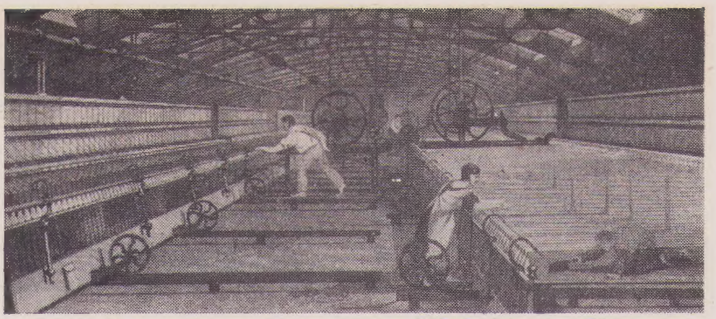
'Our enemies will seek every opportunity by the means of their sanguinary agents to excite a Riot, that they may have a pretence for spilling our Blood, reckless of the awful and certain retaliation that would ultimately fall on their heads. . . .

'Come, then, my friends, to the meeting on Monday, armed with no other Weapon but that of a self-approving conscience: determined not to suffer yourselves to be irritated or excited, by any means whatsoever, to commit any breach of the public peace.'

Henry Hunt was born in 1773, son of a Wiltshire farmer. His early political activity was centred in London, and he did not become involved in Manchester Radicalism until 1817. His brilliance as a public speaker has earned him the name of 'Orator'. He has a clear ringing voice and a tall impressive appearance, and is the accepted Radical leader throughout the country.



Henry Hunt – peaceful Radical.



In dark and steamy mills such as this, women and children like Ann Wilkinson must work long and arduous hours.

WEALTHY INDUSTRIALIST ON DEATH CHARGE

SIMON GROOGLE, a wealthy industrialist who owns several cotton factories in the Lancashire area, appeared in court yesterday, charged with causing the death of seven-year-old Ann Wilkinson who collapsed from exhaustion after working 17 hours without a break at her job as a cleaner.

The Factory Act of 1802 ordered that children should not work more than a 12-hour day. Groogle is also charged with violating the Second Factory Act passed earlier this year, which laid down that no child under the age of nine was to be employed in a cotton factory.

Groogle pleaded not guilty to the first charge on the grounds that Wilkinson was not a legal parish apprentice, and therefore did not qualify for protection under the Act. He also pleaded not guilty to the second charge on the grounds that the girl's mother had told him Ann was 10 years old. He therefore pleaded guilty to violating another clause in the Second Factory Act which laid down that children between nine and 16 were not to work more than a 12-hour day.

The case was adjourned.

CATHOLIC REJECTED

WILLIAM HARVEY had his nomination for the Totnes Committee of Public Safety rejected yesterday, because he is a Roman Catholic. Catholics have no civil rights by the Acts of Test and Corporation. Every office holder, civil or military, is obliged to receive the Sacrament according to the rites of the Anglican Church. This law is often by-passed in the case of Low Churchmen, but is usually enforced in the case of Catholics and Jews.

FOCUS ON GLOOM TOWN

Manchester – the name is synonymous with disorder.

A new mill in Union Street; just one of Manchester's many eyesores (see 'Satanic Mills', page 3).

EVEN before 'Peterloo', Manchester was a centre of Radical discontent. Two years ago, on 10th March 1817, another meeting gathered in St Peter's Field. This was the famous meeting of the 'Blanketeers' who were to march into London and present their grievances to the Prince Regent. Before they could begin their march police intervened and eventually only one man reached London.

The meeting yesterday was just another symptom of Manchester's extreme Radicalism which is actively supported by the influential newspaper, *Manchester Observer*. However, Manchester's reputation as a hotbed of violence and revolution has now reached a new peak. Why should the town's name be synonymous with disorder?

In 1773 the population of Manchester was about 24,000. Today it is in the region of 100,000. This unprecedented growth is largely the result of the extraordinary development of the cotton industry, and all over Manchester cotton factories are mushrooming. The bulk of the people are engaged in one of two processes: spinning or weaving. There are some 20,000 people employed in over 60 spinning mills in the Manchester area, the majority being women and children engaged not as spinners operating the mules but as reelers, carders and piecers. They work 15 or 16 hours a day, and live in overcrowded, unsanitary buildings – often a dozen or more to one room.

But the spinners, who can earn up to 30*s* a week, are far better off than the 40,000 or so handloom weavers who work at home, none of whom earn more than 12*s* a week for a 16-hour day. Ten years ago they were earning double this amount, but all classes have been hit by the trade depression. Last April the *Manchester Observer* declared, 'At this season all used to be bustle and activity – when our tradesmen had scarcely time to bid you good morning – we are now a mass of worse than still-life – all is now doubt and despondency.'

The weavers have become converts to the Radical cause, and were certainly out in great numbers at Peterloo.

Manchester, it seems, has grown too fast, too quickly. There are more people than there are homes, more men than there are jobs, more workers than the market can take. Its houses have been thrown together in a hurry, its people live in shocking conditions. Well might the poet Robert Southey write 12 years ago that Manchester consisted of a 'multitude crowded together in narrow streets, the houses all built of brick and blackened with smoke; frequent buildings among them as large as convents, without their antiquity, without their beauty, without their holiness; where you hear from within . . . the everlasting din of machinery; and when the bell rings it is to call wretches to their work instead of their prayers'.

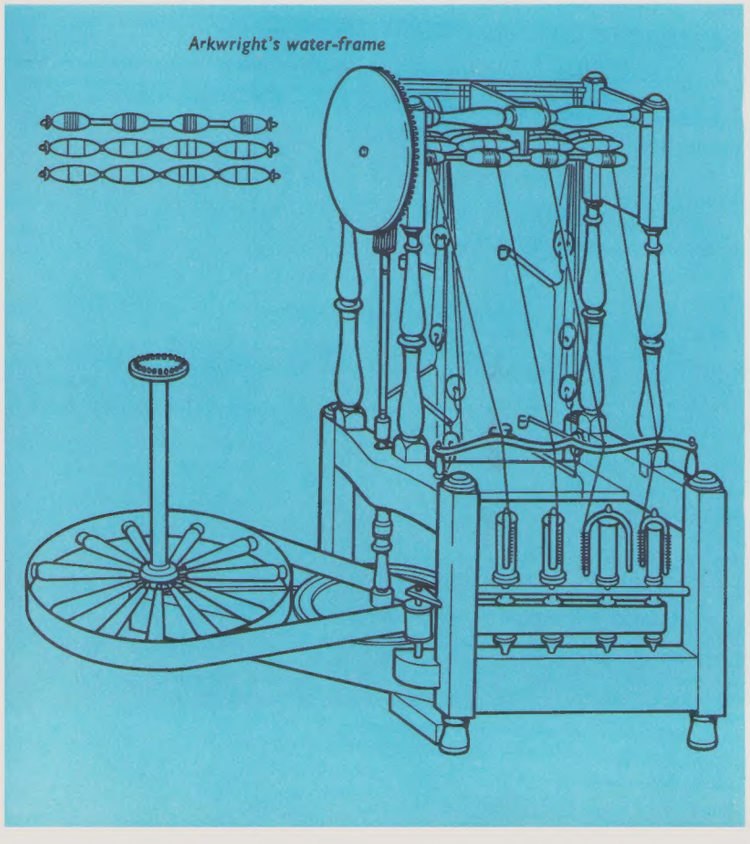
RICHARD ARKWRIGHT

RICHARD ARKWRIGHT has been called the founder of the factory system. His invention of cotton spinning machinery which would do the work of scores of pairs of hands, and the cotton mills which he built, laid the foundations of the Industrial Revolution.

Early disadvantages of cotton

Before we can fully understand the revolutionary changes which were introduced by Arkwright, we must take a short look at the history of cotton spinning and weaving. Although cotton has been known for thousands of years in the Middle East, it was not introduced into Europe on any great scale until the Middle Ages. It reached England when the craft of cotton spinning was brought over by immigrants from the Low Countries in the late 16th century. These early cotton spinners worked in their own homes and spun and wove the cotton entirely by hand. Unfortunately, hand-spun cotton is irregular in thickness and rather weak, so that at this time, and for a century and a half afterwards, cloth could not be woven entirely from cotton. Instead a material called *fustian* was produced which used strong linen threads for the *warp* (the threads running lengthways through the material), while the weaker cotton was used only for the *weft* (the threads running across the width of the material). Since linen was more expensive than cotton, and in shorter supply, there was a great need to find some way of producing really strong cotton threads so that all-cotton cloth could be made which would be strong enough to wear well.

In 1733 John Kay invented the flying shuttle which made it possible for a weaver to produce a wider cloth, and to weave more quickly. With the improvement in weaving there came an increased demand for cotton thread, and about 1767 James Hargreaves introduced the *spinning jenny*, a machine which made it possible for one person to spin 12, or even 24, threads at the same time. The spinning jenny was, however, operated by hand, and although it produced more cotton than the older spinning wheel, the quality was no better. The production of cotton thread which could be used for the warp of a material remained a problem, and Richard Arkwright was the man who solved it.



Arkwright's water-frame

Sir Richard Arkwright (1732–1792)

Arkwright's early life

Arkwright was born in Preston in 1732, and was the youngest of 13 children. In about 1750 he moved to Bolton and for some years ran a wig-making business and a barber's shop. About 1767 he gave up this trade and turned to the design of textile machinery. In collaboration with John Kay, a watchmaker of Warrington, Arkwright built the first cotton spinning machine which was designed to be power driven, and which would produce thread which was both uniform and strong.

Arkwright's first spinning machine was tested at the Free Grammar School at Preston in 1769, and proved highly successful. Soon afterwards he moved to Nottingham, where he built a small factory in which cotton was spun on his machines. In this factory the machinery was driven by horses, but in 1771 a larger mill was built at Cromford in Derbyshire, and here the machinery was driven by water wheels. In the next few years Arkwright, with the help of Jedediah Strutt and Samuel Need, built mills in Lincolnshire, Lancashire, and Scotland. His water-driven machines were known as *water-frames*.

The growth of factories

Arkwright's machines could be operated by unskilled labour, and in many mills children of nine years old or even less were employed. As a result of this, the old craftsmen who spun by hand found themselves unemployed, and Arkwright became very unpopular among them. In 1779 a mob sacked one of his mills at Chorley, but the progress of machine-made cotton was scarcely interrupted.

In 1775 Arkwright introduced another machine into the cotton industry, an improved *carding engine*. The carding engine was a machine which combed out the tangle of fibres forming the raw cotton and laid them all parallel, so that they were ready for the twisting and stretching process which was carried out on the water-frame. With this improvement it became possible to mechanise the whole process of cotton thread production. In 1790 Arkwright introduced a steam-driven beam-engine made by James Watt into his Nottingham mills.

Richard Arkwright was knighted in 1786 and died in 1792. He was buried at Cromford church, which he had built, not far from the site of his first water-powered mill.

TYPES OF FRUIT

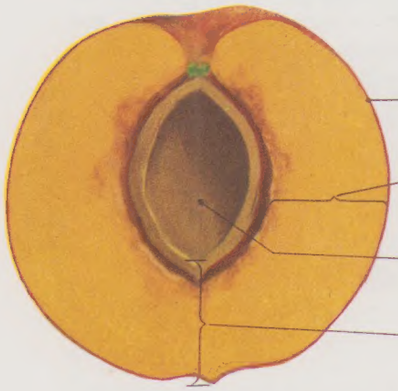
HAVE you ever looked through an illustrated catalogue issued by a horticulturist specialising in fruit? There are usually pages and pages of colour photographs of fruit, each one looking more luscious than the last – apples, pears, plums, damsons, raspberries, strawberries, and many more. Yet all this variety is nothing compared with the diversity of fruits occurring in nature.

The reason for this was made clear in our article on the dispersal of seeds (see page 1108). The fact is that the word 'fruit' conveys two very different meanings to the ordinary person and to the botanist. Most of us use the word to mean a vegetable product that is edible and at the same time sweet and succulent, like a plum or a strawberry. To a botanist a fruit is that which is formed from a flower after fertilisation has occurred and the ovules have developed into seeds (see page 1047). It follows from this that every kind of flowering plant produces a fruit of some kind. You see now why we need a whole article to give you even a brief introduction to the subject of fruits.

The purpose of a fruit is firstly to provide protection for the seed, and secondly to help the seed to find a place where it can germinate and grow. Its second function is known as dispersal, and this can be achieved in many different ways. The development of sweet, succulent fruits, to entice animals to eat them and so carry the seed away, is only one of them. Fruits are classified according to how they develop from the flower, and so we will treat them in this way in the account which follows.

A little anatomy

We have already described the anatomy of fruit in some detail (see page 1774), but it will be as well to look again at the parts that go to make up a typical fruit – for example, a peach.



PARTS OF A PEACH

outer skin, the epicarp

thick intermediate fleshy part, the mesocarp

inner woody stone, the endocarp

the three together form the pericarp

Remember that a true fruit is formed by the swelling and transformation of the fertilised ovary. However, sometimes other parts of the flower, including the receptacle, petals, and sepals, contribute to its formation.

Fruits can be divided in the first place into two groups: succulent fruits and dry fruits.

The first can be classified as true or false fruits; the second as dehiscent or indehiscent. Now let us see what these definitions mean.

SUCCULENT FRUITS

These are fruits with a fleshy pericarp, and are usually juicy and sweet. Most edible fruits, apart from nuts and legumes, are included in this group.

TRUE SUCCULENT FRUITS

These are succulent fruits formed solely by the development of the flower's ovary.

DRUPE. The type of fruit with a single stone in the centre, such as plums, cherries, peaches, and (rather unexpectedly) walnuts. It has a thin epicarp, fleshy mesocarp, and hard stone or endocarp, which contains and protects the seed.

FALSE SUCCULENT FRUITS

These are fruits which are made up of the ovary and other parts of the flower as well. Typical examples are the apple and pear, which have flowers with the ovary *inferior* and enclosed in the receptacle (see page 1046). Both the receptacle and ovary enlarge and become succulent.

The outer part of the fruit, which we eat, comes from the receptacle; the ovary develops into the central part or core, which contains the seeds.

DRY FRUITS

These are fruits in which, when the seed is ripe, the pericarp is tough or hard, and dry.

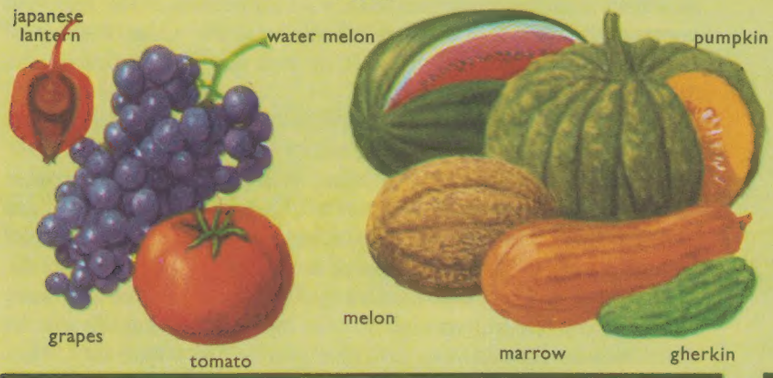
DEHISCENT DRY FRUITS

This type of fruit, when it is ripe and dry, splits open of its own accord to release the seeds.

LEGUME OR POD. The pod is characteristic of the pea and bean family of plants, the Leguminosae. Each pod contains a number of seeds which are often edible and very nourishing.

BERRY. This differs from the drupe in having a pericarp which is fleshy throughout with no hard endocarp, and in containing several seeds.

PEPO. This is a special form of berry in which the endocarp is fibrous or stringy; the mesocarp is fleshy and the epicarp often a hard rind. The pepo of the gourd can be cleaned out and the epicarp used as a water vessel.



HESPERIDIUM. This is another special kind of berry and includes the fruits of the citrus family, such as oranges and lemons. The epicarp is the thick rind or skin, the mesocarp the white pith-like substance just inside it, and the endocarp is the tough membrane that surrounds each of the segments. The part that we eat does not strictly belong to any of these, but is just a sweet, watery tissue surrounding and protecting the seeds.

FLESHY INFRUCTESCENCES

We have seen (page 320) how flowers are often arranged in bunches or groups called 'inflorescences'. Sometimes all the flowers making up an inflorescence become fleshy and form a single fruit-like structure, called an 'infructescence'.

The fig is an infructescence. The little 'seeds' inside are really separate fruits, of the sort called achenes. This peculiar type of fruit formation is not very common; mulberries and pineapples are other examples of it.

COMPOSITE FRUITS

Sometimes a single flower will have not one but a number of ovaries. When they are fertilised the result is a bunch of little fruits all growing together.

Blackberries and raspberries are formed in this way and consist of bunches of little drupes, which are called 'druplets'. In the case of the strawberry, each pip is a fruit (an achene) and the fleshy part is the receptacle. A strawberry is therefore a false fruit besides being composite.

SILIQUA. Like a legume, but there is a partition which divides it into two compartments, and on which the seeds are borne. Wallflower family.

CAPSULE. A dry composite fruit (see above) which opens to release the seeds. It may split or have a lid or open in segments. Some open suddenly, scattering their seeds.

INDEHISCENT DRY FRUITS

These are dry fruits which, when ripe, do not open of their own accord.

ACHENE. A fruit consisting of a seed with a dry, horny covering. Sunflower and carrot 'seeds' are achenes.

CARYOPSIS. The fruit of plants belonging to the cereal and grass family. It is an achene in which the pericarp is united with the seed-coat. The edible grains like wheat and maize are caryopses.

SAMARA. A kind of achene which is winged to allow for dispersal by the wind. Sycamore, elm, ash.

NUT The structure is similar to that of an achene, but the fruit is larger and the outer covering often hard and woody. The hazel nut and acorn are nuts, but the walnut (as we have already mentioned) is a drupe.

HENRY III AND SIMON

Henry III (1216–1272)

FOR many centuries Simon de Montfort has been revered as the virtual founder of the House of Commons, as the man through whom a Parliament of two chambers was first brought into being. But on 4th August 1265 Simon was defeated in battle against the forces of his lawful king. He was killed and his body was cruelly mutilated. Christian burial was refused him, and he was branded as the blackest of traitors. How did this tragedy come about?

Early life

Simon, like so many men prominent in English mediaeval history, was a Frenchman by birth. Montfort-l'Amaury, his family seat, is not far from Paris. His father was one of the leaders of the bloody Albigensian Crusade, when the great civilisation of the south of France was shattered by barons from the north, profiting from the fact that the south was a hotbed of heretics. We know little of Simon's upbringing, but in 1230 he came to England, to the court of the young Henry III, chiefly perhaps to claim the earldom of Leicester, once held by his grandmother. The earldom was granted to him, and he advanced himself even further in English social life when he obtained permission from Henry III to marry the King's sister Eleanor.

As brother-in-law of the King, Simon was indeed a great man, but his rise to royal favour gained him no popularity. To most English nobles he was just one more of the many foreigners with whom young Henry surrounded himself and on whom he showered favours. Nor did Simon's personality help him. On occasions he could be charming, and he had great ability, but he was proud and obviously ambitious. He also had some of his cruel father's ruthlessness. He had important friends – like Robert Grosseteste, the great Bishop of Lincoln – but many enemies. If he lost the King's favour, he might well lose much more.

Henry III

King Henry was the son of King John, the most unpopular though by no means the worst of all English kings. When John died in 1216, Henry was only nine; and for many years the government was in the hands of a regency, governing in the spirit of the Magna Carta of 1215. But the time came in 1227 when Henry felt old enough to take power for himself, and he soon showed that he was not going to be very wise in his use of it.

After the regency, and after the struggles of John's reign, it was difficult for any king to rule without the help and co-operation of the barons, who now felt they had a right to a say in government. But Henry preferred a few close advisers, and he chose to draw them from among the friends or kinsmen of his wife or his mother – that is, from France. The barons of England had become used to holding many of the great offices of state, but Henry passed over them and governed through his own favoured clerks. This might not have mattered if Henry had governed well. But his reign was a succession of failures in foreign policy – as John's had been – and the money to pay for these failures had to come from many of the very men whom Henry was excluding from power. It was a situation full of danger; and the son of King John was not accustomed to acting with tact or moderation.

The provisions of Oxford

In the conflicts between Henry and the barons, Simon de Montfort was to end up as the King's greatest opponent and the leader of his enemies. But at first Simon was on the King's side. Only in 1239 did the first breach open between them. We do not know many of the details of it, but it seems to have been a quarrel over some money transaction. Simon left England in high dudgeon – a favourite practice of his – and though there was a reconciliation the two men were always suspicious of one another after it. In 1248 Simon was given the very difficult job of governing the English province of Gascony, in one of its frequent periods of rebellion, and this was to lead to an even worse personal quarrel with Henry. Simon did his job in Gascony all too well. The Gascons complained; and Henry, instead of supporting his own appointed deputy, started an official inquiry into Simon's governorship. He could not find very much wrong with it, but the proud Simon was furious at the insult. Henceforward, though he might occasionally support the King, he could never like him. Once more he retired to his estates in France.

During the 1250's the King's taxation became heavier and discontent in England grew. The English barons were determined to make a stand against the King. And in 1258, at a Parliament in Oxford, Simon threw in his lot with them, forcing the King to agree to some 'Provisions' which set up a committee of barons to keep watch on the government. Simon was still not among the extremists, but when in 1261 the King felt strong enough to revoke the Provisions and throw out the committee

DE MONTFORT

of barons the disgusted Simon left England yet again. Next time he came back not as a moderate, not as a conciliator, but – on the invitation of the barons – as a rebel.

Simon the ruler

He did not at once give up all hope of agreement. He allowed the King to take the dispute to the great St Louis, King of France. But when, at Amiens, Louis declared for Henry, Simon knew that force was the only answer. At the Battle of Lewes in Sussex, in May 1264, he and his barons defeated the King and his son Edward, taking them prisoner. Simon de Montfort was now the ruler of England, but this was to last only for the brief period of 15 months.

He ruled officially as one of three 'electors'. The other two were the Earl of Gloucester and the Bishop of Chichester; but Simon made it clear that the other two were to be mere figureheads and that he was going to rule not as the voice of the ambitious barons but as a kind of constitutional monarch. It was at this point that Simon called into existence the House of Commons; for in order to get the maximum of support and in order to get some money he called representatives of the knights of the shires and of the towns to the Parliament of great spiritual and lay lords.

This was a shrewd move, since much of Simon's support came from these knights. But the powerful barons did not like it. Nor did they like it when Simon began investigations into their handling of their own estates. His supporters began to dwindle, and when Henry's son Edward escaped from imprisonment he found plenty of people ready to overturn this government of the upstart Earl of Leicester.

The end at Evesham

Edward – the future Edward I and one of the greatest of English kings – was a man of skill and energy. He collected an army and soon had Simon trapped in a bend of the river Avon at Evesham. Simon's cause was hopeless, but he fought bravely to the end. And there could be only one end for a man who had dared to rule in the place of his king. Simon met it in battle rather than on the executioner's block. He met it as a traitor, and the pieces of his dismembered body were sent to the four corners of the kingdom. His followers were killed or heavily fined. His name was execrated in the Court (this meant that his heirs were forbidden for ever to hold his land or enjoy the rights of the English peerage). But by many of the common people of England he was for many years honoured as a martyr. And he has his place of honour now, in the palace of Westminster.

Simon de Montfort, Earl of Leicester, riding into battle

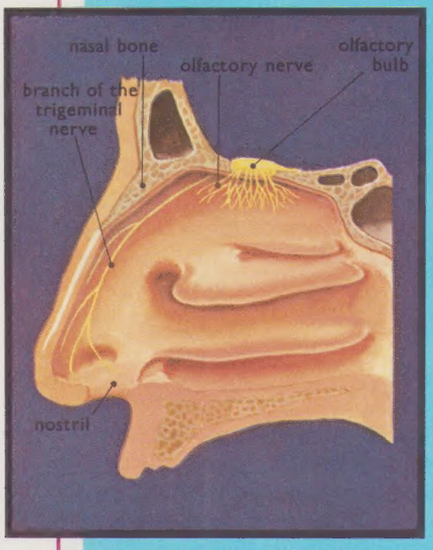
Edward I was a stern but wise man. He did not rule as his father had ruled but rather as Simon had wished his father to rule. The knights and burgesses continued to be summoned to Parliament, at first occasionally but later automatically. Simon did not consciously found a new and permanent organ of English government. For him the calling of the Commons was the move of one who was politically weak, and wished, by some means or other, to become stronger. But Simon de Montfort, nevertheless, had laid the foundations of the present British Parliamentary system.

The Battle of Evesham (1265) *in which Simon de Montfort was killed*

SENSE OF SMELL

FOR reasons which are sometimes only too obvious, noses are often the butt of unkind and personal jokes. The owners of unusually large or unusually long noses are particularly subject to this sort of humour. Nevertheless, though these unfortunate people may sometimes wish that their noses were a little less conspicuous, they would certainly not like to be without them. The human nose, large or small, is extremely useful. It is not only the uppermost part of the respiratory tract but it also contains the organ of smell.

In everyday speech 'nose' simply means the feature in the front of the face, which is divided into two *nostrils* by the central *septum*. To the anatomist, however, 'nose' means also the spaces in the skull into which the nostrils lead, and which themselves lead backwards into the *nasopharynx*. If you look at the strange illustration in the black panel you will see how this is arranged.

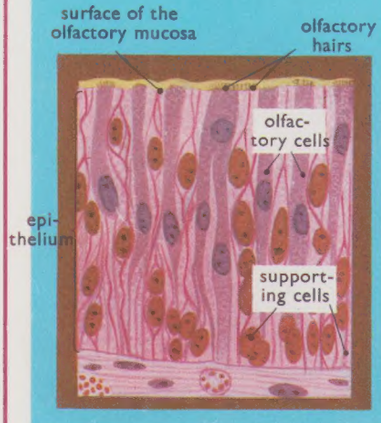


This section of the nasal cavity shows the way in which the olfactory nerve is distributed over the upper concha and the space above it

This picture is a view of the nose as you would see it if you could place your eye in the position of the septum.

On the left you can see a nostril. The nasal bone and the cartilage which support the nose are visible too. At the bottom of the picture is the upper jawbone, the *maxilla*, and the hard palate.

Most of the illustration is taken up with the side wall of the part of the nose that lies in the skull. The three bulges, which are called the *conchae*, are ridges of bone covered with mucous membrane. The air passages between them are called *meati*. The uppermost concha is much smaller than the other two, and it is in this area of the nose that the sensory fibres of the nerve of smell, the *olfactory nerve*, are spread.



Section of the olfactory mucosa (magnified about 450 times)

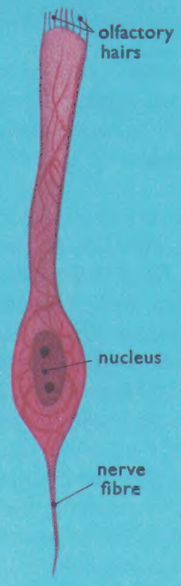
THE NASAL MUCOSA

The air that passes through the nose with each breath goes mostly through the three meati. Here the mucosa is red and thick, for its task is to trap particles of dust and to prevent them from reaching the lungs.

The mucosa in the top part of the nose is quite different. It is thin, yellow in colour, and it contains the olfactory cells. It is often called the *olfactory mucosa*. Under a microscope it is seen to have a very special structure.

In the picture you can see that the olfactory mucosa is formed of two sorts of cell. The large sort are the *supporting cells*. They form a groundwork between which the smaller, narrower *olfactory cells* lie.

The olfactory cells are the smell receptors. At the free end of each are minute *olfactory hairs* which project into the nasal cavity. At the inner end, each cell tapers off to form a fibre of the olfactory nerve.



An olfactory cell (magnified about 1,000 times)

HOW THE SENSE OF SMELL WORKS

As most of the air passing through the nose goes through the three meati during normal breathing, the delicate olfactory mucosa is protected from the drying effect of the passage of large volumes of air. A little of each breath, however, diffuses upwards to reach the olfactory mucosa, and as it does so it carries to the mucosa any smelly substances which the air contains. When enough of a smelly substance is present in this air, a smell is perceived. After this, the sensation can be intensified by sniffing. This action draws air into the nose much more rapidly than in normal breathing, and in doing so brings more air, and so more of the smelly substance, into contact with the olfactory mucosa. In this way the mucosa is subjected to a greater stimulus, and so the smell appears stronger and is easier to recognise.

We cannot really understand the reason why some substances smell and others do not. However, it is known that all smelly substances are either gases or volatile solids or liquids. Molecules of all such substances can thus be present in the air and come into contact with the olfactory hairs. This contact stimulates the cells bearing the hairs to discharge nerve impulses along the fibres at their deeper ends. These impulses travel along the fibres in the olfactory nerve to the olfactory bulb, from which they are relayed to the brain. After a complicated course the impulses reach that part of the brain called the *hippocampus* where they are perceived in consciousness as a sensation of smell.

THE SENSE OF SMELL IN ANIMALS

Although humans find their sense of smell quite useful, it is, in fact, a sense which is very poorly developed. Through millions of years humans have come to rely so much on their excellent sight that their olfactory sense has declined. All other mammals have a sense of smell which is vastly superior to that of humans. So much so, that it is reasonable to say that whereas humans live in a world of sights, other mammals live in a world of smells.

THE FIRST VOYAGE OF COLUMBUS

IN 1492, after ten years of study, entreaties, and struggles, Christopher Columbus realised his ambition. Ferdinand and Isabella, the King and Queen of Spain, had granted him three ships to make a voyage across the uncharted ocean to the 'Land of the West'. His intended destination for the voyage was Asia, the rich countries of Cipangu and Cathay, which we now know as Japan and China. Maps like Toscanelli's (see page 1944) had led him to believe that he could reach Asia by sailing west, without coming across other land on the voyage. Columbus had also been given letters to the Great Khan of Cathay and the Emperor of Cipangu.

The voyage begins

On the first page of his diary Columbus wrote: '*In nomine Domini nostri Jesu Christi*' (In the name of our Lord Jesus Christ), and then, after a message of loyalty to Ferdinand and Isabella, his patrons, he wrote: '*Friday, 3rd August* 1492. *Set sail from the bar of Saltes* [at Palos, a harbour north of Cadiz] *at* 8 *o'clock, and proceeded with a strong breeze till sunset.*'

The ships

The three ships were called the *Santa Maria*, the *Nina*, and the *Pinta*, and were provisioned at the expense of Palos in southern Spain. No exact description of them can be given, but they were probably *caravels*, a loose term for rather narrow, fast merchantmen, carrying three masts: the main-mast in the centre, a little taller than the length of the ship, the fore-mast, about half the main-mast's height, and the mizzen, set in the stern. The fore- and main-masts were square-rigged, but the mizzen probably carried a *lateen* or triangular sail.

The ships were stoutly built, brightly painted above the water-line, and caulked with pitch below it to preserve the timber, and because it was believed at that time that pitch prevented barnacles fastening upon the keels. Above the ships fluttered the flags depicting the lions and castles of Ferdinand and Isabella.

The two larger ships, the *Santa Maria* and *Pinta*, had raised structures fore and aft, called castles. The captain's cabin was in the aft-castle, where the officers also slept, each with a bed and sea chest. The crew slept where they could in the forecastle, among the stores of equipment, food, barrels of water, and ammunition for the guns. Each ship carried a pilot and a doctor, and there were also interpreters, who presumably spoke Chinese and Japanese, and secretaries aboard.

Some facts about the ships

The *Santa Maria* was the flagship; she was probably not a true caravel but a *nao* – a rounder and less speedy ship. Her original name was *La Gallega* (the *Galicia*), but she became known to history as the *Santa Maria*. This ship had a tonnage of about 100, was approximately 90 feet long, and 20 feet wide. She carried just over 50 men.

The *Pinta* was about 50 tons, and captained by Martin Alonzo Pinzon, one of a powerful family who were well-known navigators and ship-owners. It was from her deck that land was first sighted, and it was the *Pinta*, too, which first reached Spain at the end of the return journey.

The smallest caravel, the *Nina*, about 40 tons, was captained by Vincente Yanez Pinzon, younger brother of the *Pinta's* captain. She began the voyage with lateen sails, but was fitted with square sails when the ships arrived in the Canaries.

THE CREW

The total crew amounted to about 100, mostly men from Palos in Spain, who had been unwillingly 'pressed' to serve. The only foreigners were the Genoese Columbus, another Genoese, a Portuguese, and a Venetian.

THE THREE CARAVELS

Santa Maria

Pinta

Nina

THE ROUTE OF THE FIRST VOYAGE OF COLUMBUS

Columbus kept a diary which gives a vivid picture of the voyage of the three little ships across the unknown waters of the Atlantic.

FRIDAY, AUGUST 3RD 1492. Columbus's small convoy left the river port of Palos for the open sea, sailing southwards towards the Canary Islands.

TUESDAY, AUGUST 7TH. The *Pinta's* rudder broke loose for the second time. She made for the Grand Canary, while the others sailed for the island of Gomera. The Admiral returned to superintend repairs to the *Pinta*. As they left Grand Canary, the volcano of Tenerife rumbled threateningly, and hurled flames and ashes into the air. The crew cursed it as the bringer of ill luck, for its eruption was regarded as a bad omen.

THURSDAY, SEPTEMBER 6TH. Having brought on board wood, water, meat, and other provisions, the Admiral left Gomera in good weather.

SUNDAY, SEPTEMBER 9TH. Columbus sailed 15 leagues on this day, but he decided to record less than the true number, so that the crew might not be dismayed or frightened if the voyage seemed long. The helmsmen steered badly, letting the ship drift towards the north-east, for which the Admiral reprimanded them repeatedly. To reach Cathay and Cipangu, Columbus sailed due west from the Canaries, and continually deceived his sailors about the distance they had covered, for he knew well that they were dissatisfied. Columbus was convinced that the crossing of the ocean would take only a few days!

SUNDAY, SEPTEMBER 16TH. The weather was fine, and the Admiral noted in his diary: '*The mornings were the most delightful; the only thing wanting was the song of the nightingales. The weather was like that of Andalusia* [a district of southern Spain] *in April.*'

SUNDAY, SEPTEMBER 23RD. On this day they were sailing through the thick, weedy waters of the Sargasso Sea. It was so calm that the sailors grumbled, saying that there would never be enough wind to carry them back to Spain. A headwind blew up, however, which calmed their fears.

Many times they believed they were near land: flocks of birds were seen, and weed floated on the surface of the water. Once a huge bank of cloud convinced them that they had reached the Indies.

WEDNESDAY, OCTOBER 10TH. Still no sight of land. The caravels had been sailing for 34 days since leaving the Canaries, during which time they had seen nothing but sky and sea. The men grew mutinous and threatened to turn back, but Columbus wrote in his diary: '*The Admiral encouraged them, reminding them of the profits they would gain, and adding that it was pointless to complain, having come so far. There was nothing for it but to continue on to the Indies, till, with the help of God, they should arrive there.*'

LENGTH AND SPEED OF THE VOYAGE

The total distance covered by Columbus's ships from Palos to San Salvador was about 3,745 miles.

The ships attained an average speed of about eight knots throughout most of the favourable conditions, but were often reduced to three or four knots when conditions were unfavourable.

THURSDAY, OCTOBER 11TH. Land was now obviously near. The men saw tufts of grass, branches of trees, and a twig with red berries. The diary continues: '*After sunset steered on their course westward until two hours before midnight. Because the* Pinta *was the swiftest ship, she discovered land.*' (It is not certain whether this took place on the 11th or 12th.)

Ferdinand and Isabella had promised 10,000 maravedis annually (£200 a year) to the sailor who should first sight land, and Columbus had promised a silk jacket as well. The long-hoped-for cry: '*Land! Land!*' was sent up by a sailor in the *Pinta*, Rodrigo de Triana. The Admiral, too, had seen a light '*like a small wax candle moving up and down*'.

FRIDAY, OCTOBER 12TH. They shortened sail early in the morning, and waited till dawn, when they found themselves off a small island. It is usually said that this was Watling's Island in the West Indies, called by Columbus San Salvador. They found the natives friendly. '*They came swimming to the boats, bringing parrots, balls of cotton thread, spears, and many other things, which they exchanged for articles which we gave them: glass beads, hawks' bells, and so forth.*'

For nearly three months Columbus sailed among the West Indian islands, exploring Cuba and Haiti, which he named Juan and Hispaniola. He enquired everywhere for the Great Khan, and also for evidence of the gold and riches which he had promised his Spanish sovereigns. Though he did not find all he hoped for, he found enough to convince Ferdinand and Isabella, on his return, that these lands were rich in material wealth, and their inhabitants friendly and trusting enough to serve them like slaves.

Columbus was still firmly convinced (and he remained so till the end of his days) that these islands were the East Indies of which Marco Polo had written, and that Cathay and Cipangu must lie near at hand.

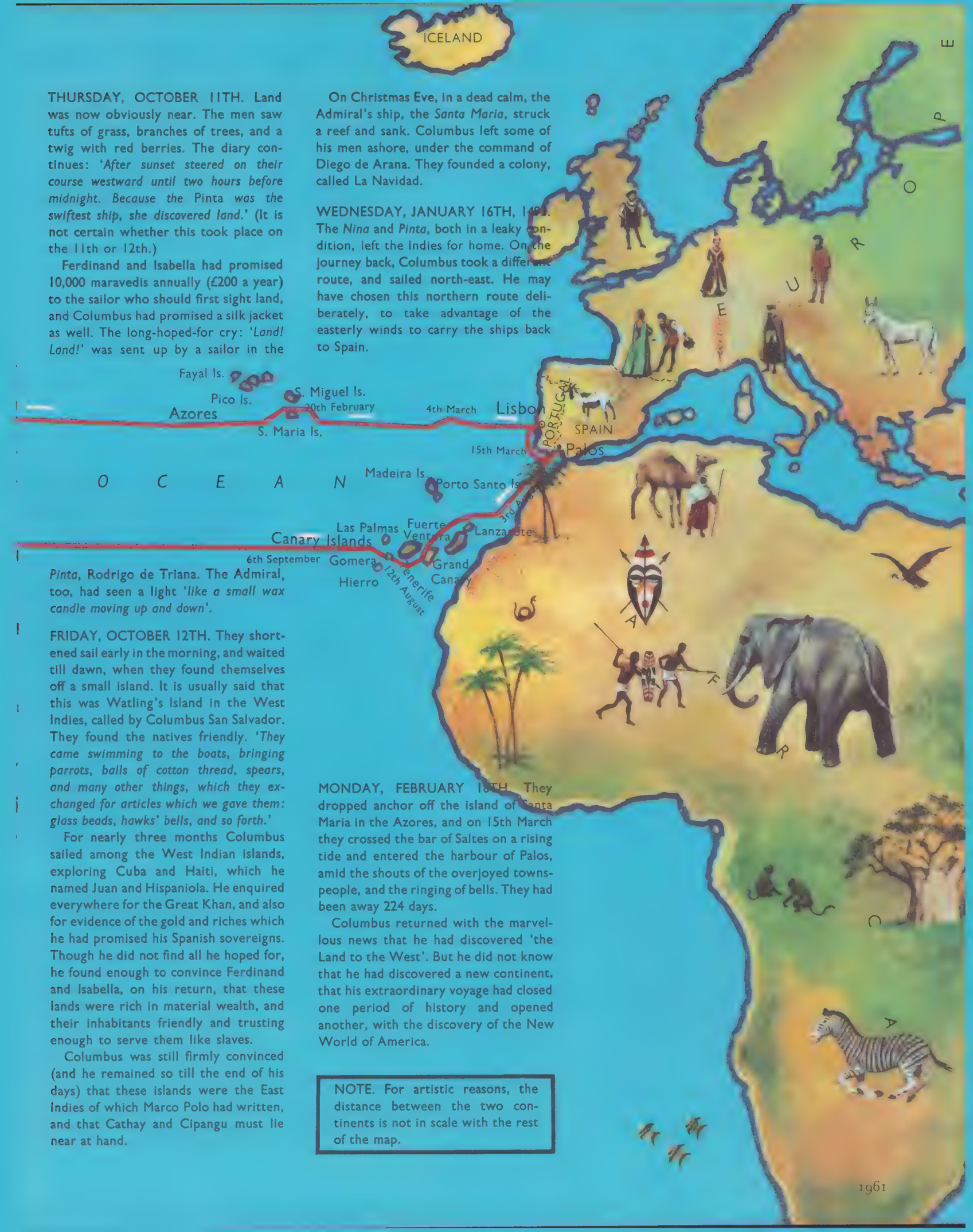
On Christmas Eve, in a dead calm, the Admiral's ship, the *Santa Maria*, struck a reef and sank. Columbus left some of his men ashore, under the command of Diego de Arana. They founded a colony, called La Navidad.

WEDNESDAY, JANUARY 16TH, 1493. The *Nina* and *Pinta*, both in a leaky condition, left the Indies for home. On the journey back, Columbus took a different route, and sailed north-east. He may have chosen this northern route deliberately, to take advantage of the easterly winds to carry the ships back to Spain.

MONDAY, FEBRUARY 18TH. They dropped anchor off the island of Santa Maria in the Azores, and on 15th March they crossed the bar of Saltes on a rising tide and entered the harbour of Palos, amid the shouts of the overjoyed townspeople, and the ringing of bells. They had been away 224 days.

Columbus returned with the marvellous news that he had discovered 'the Land to the West'. But he did not know that he had discovered a new continent, that his extraordinary voyage had closed one period of history and opened another, with the discovery of the New World of America.

NOTE. For artistic reasons, the distance between the two continents is not in scale with the rest of the map.



THE SPIDER

EVERYONE is familiar with spiders' webs, and most people know that spiders construct them of silk, which they make by squeezing out a special liquid which hardens to form a thread on contact with the air. Of course, they are not the only creatures that make silk in this way; silkworms and other caterpillars do so too. But a spider's life depends on its silk-spinning to such a degree that any study of it is largely a study of webs, and of all the other curious uses to which it puts the fine delicate silk which it spins. Most of the webs we see are made by female spiders; the male spends much of his time wandering in search of a mate.

VARIOUS KINDS OF SPIDERS

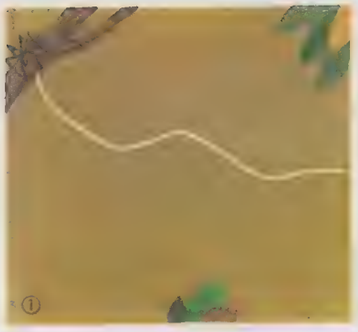
About 580 kinds or species of spiders are known to inhabit Britain, and the world total is several thousand. Some of these are tiny, others as big as your hand. A few are dangerously poisonous, but you have nothing to fear from any British spider.

We have told you about the anatomy of the spider already (see page 1092). The picture above will remind you that a spider has eight legs, and a body divided into two parts: the cephalothorax and the abdomen. The species shown here is a garden spider, *Araneus diadematus*.

The end of a spider's leg, greatly enlarged. Note the comb-like apparatus, which guides the web as it is spun

An expert spinner

If you were lucky enough to see a garden spider just as it began to make its web, and were patient enough to watch it from start to finish, you would see the complicated process which is shown in the series of pictures on the right.



① The spider stands on a twig and squeezes out a thread which is wafted away by the wind; if she is lucky, its end catches up in something, perhaps another twig. She pulls to make sure it is firm, sticks it down at her own end of it, and then walks across it and back several times, laying down additional threads to strengthen it. This first, more or less horizontal, thread is called the *bridge line*, and forms the foundation of the web.

② and ③ Below the bridge line she builds a vertical frame, which may be triangular (as we show it) or four- or five-sided. Its shape does not matter so long as it is all in one plane – that is, flat, as it would be if it

Why does the spider spin?

The spider that makes a web does so in order to catch the flying insects on which she feeds. She waits, either at the centre or in a lair beside the web, holding a thread, whose movement will tell her when an insect is caught and whereabouts in the web it is entangled. As soon as one is caught she runs across the web to it and quickly bundles it up in a sort of parcel of silk. Then she kills it with a poisonous bite and sucks it dry. If a spider catches a dangerous insect like a wasp, she will deliberately cut the web and let it go.

Spiders use their silk for many purposes besides making a web. Some of them live in burrows, which they line with silk so that they are watertight, and they may make a silken lid or trapdoor to the burrow. The jumping spiders live on walls and fences, and stalk flies as a cat stalks a bird. When one of these jumps on its prey, both fall, struggling together, but they do not fall far, for the spider never jumps without first dabbing down the end of a thread of silk strong enough to hold the weight of herself and her victim; when she has killed it she climbs up the thread again, carrying the fly with her.

The little money spiders even use their silk to fly with. They climb to the top of a plant or bush and pay out a thread just as the garden spider does when she makes her 'bridge line'. But the money spider's thread is caught by the wind, and when it is long enough the spider just lets go and blows away with it, perhaps for hundreds of miles, for they often land on ships at sea. Sometimes, in the autumn or late summer, these little silken kites descend in huge quantities on the grass and bushes, and we call them gossamer.

A CAREFUL MOTHER

Female wolf spider carrying her egg-cocoon

were drawn on a piece of paper.

It is made by repeated climbing, always trailing a thread behind, which is stuck down at the points which form the corners or angles.

④ When the frame is completed she drops from the centre of the bridge line to a point on the frame below, stretching a thread across as she does so. This vertical thread forms the first two spokes or radii of the web, its mid-point being the centre or hub. Then, walking along the first lower spoke to the hub, she lays down another spoke and then another. The angles between the spokes are always the same, and for each successive one she moves the correct distance along the edge of the frame. As you can see, these distances are not always the same, and we do not know how she judges the angles correctly.

⑤ She lays down a spiral thread, starting at the hub and working outwards. This is a temporary structure, and is made of ordinary (not sticky) thread. This structure is usually spoken of as the *scaffolding*.

⑥ Working from the frame inwards, towards the hub, she makes another spiral of thread which is covered with tiny drops of sticky liquid, destroying the scaffolding as she goes. Now the web is finished, and it is strong enough to catch and hold any small insect that flies into it.

This garden spider has just caught a fly in her web

Different types of web

There are many other types of web besides the wheel or orb web of the garden spider.

On the right three other kinds of web are illustrated, each spun by a different species.

① Zygiella *spins an orb web with a gap in the spiral.*

② *The triangular web of* Hyptiotes.

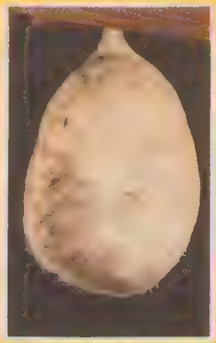
③ *Hammock web of* Linyphia montana

In the autumn the female garden spider lays her eggs in a sheltered place near her web, enclosing them in a silken bag or cocoon, and they remain there until early spring. The mother dies long before the little spiders hatch.

The wolf spider (*Pisaura*) lays her eggs in summer and carries the cocoon wherever she goes. When the eggs are about to hatch she puts the cocoon down, builds a silken tent over it, and guards it until her babies hatch and can go away on their own.

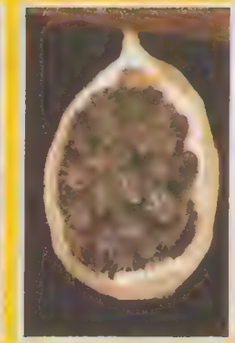
Even if you do not like spiders, you must admit they are good mothers.

Garden spider's cocoon, half made



The completed cocoon of the garden spider

The eggs have started hatching



All the little spiders have hatched

The famous racing circuit at Brands Hatch in Kent, seen from above

CAR RACING

IF you look at a photograph of a motor race of about 50 years ago, you cannot help but be amused. The cars seem as square and as high as 19th-century horse carriages; the track is rough, and deeply furrowed by the narrow wheels; moustached and bowler-hatted gentlemen crowd the rough wooden stands which line the course, and are peppered with stones and clouds of dust from the passing cars. This was the heroic era of the motor car, and of motor racing. How times have changed!

Today, most races are held on closed circuits, although some on the continent of Europe take place on public roads, which are closed for racing for just a few hours every year.

Perhaps the most famous of all road circuits is the one which runs for just under two miles through the streets of the Principality of Monaco, on the French Riviera. The famous Le Mans 24-hour race is held over about eight and three-quarter miles of public roads in a part of France known as the Sarthe. The two circuits which vie with each other for the honour of being Europe's fastest – one at Spa, in Belgium's Ardennes region, and the other at Reims, in France's champagne country – are both based on public roads, although they have permanent grandstands and other installations for motor racing.

BRITISH CIRCUITS

In Britain there is a ban on racing on public roads, so all the well-known circuits are laid out on private ground. After the Second World War, disused airfields were eagerly seized by motor clubs anxious to organise motor races, and one or two of them still survive. Silverstone was once an airfield, and so was Goodwood (Westhampnett), which has developed considerably in recent years because of the enthusiasm of the Duke of Richmond and Gordon (himself once a racing driver), on whose estate it lies. Snetterton, in Norfolk, and Castle Combe, in Wiltshire, also served as airfields before becoming racing courses.

Aintree, near Liverpool, is a comparatively new circuit, built round the outside of the famous steeplechasing course, while Brands Hatch in Kent, conveniently situated only about 21 miles from London, was once a motorcycle grass track.

THE NURBURGRING

The finest track in the world is the tortuous Nurburgring, which winds its way for more than 14 miles through the Eifel Mountains just a few miles inside Germany from the Belgian border. It was built in the early 1930's by a huge labour force which was unemployed because of the serious depression which had hit Germany. The German Grand Prix is held here, and many drivers consider it the most difficult of all circuits to learn, with over 170 corners on every lap.

The starter of a motor race

Every competing country is given a racing colour: green for Britain, blue for France, silver for Germany, red for Italy, white with a blue band for America, and so on. For an international race cars should be painted in the entrant's country's colour, but this is not strictly enforced.

There is also a system of racing flags, for the control and safety of events. The starting flag is the national flag of the country where the race is being held. Flag marshals are dotted round the course, ready to show a flag to any driver. They carry a lot of responsibility for the safe running of a race.

THE LANGUAGE OF THE FLAGS

The finish flag is the black-and-white chequer.

Blue flag waved: someone is trying to pass you.

INTERNATIONAL ORGANISATION

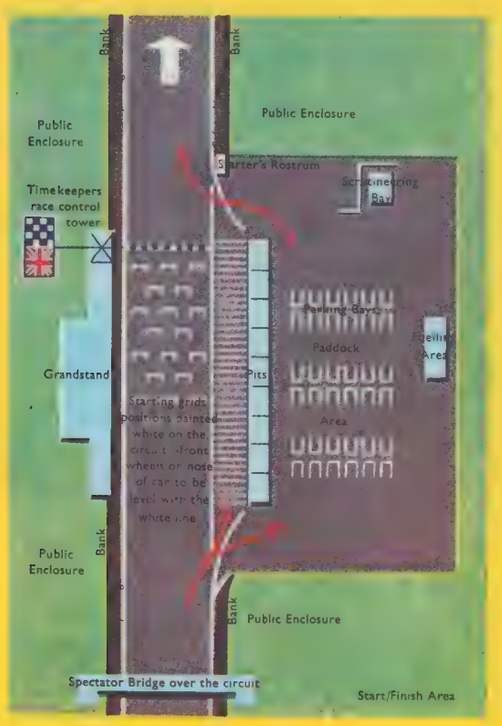
Today, motor racing is organised on an international basis, according to rules laid down by a governing body whose headquarters are in Paris. This is the *Federation Internationale Automobile* (FIA), which has a sporting sub-committee (CSI).

The CSI draws up the various regulations for racing, which include technical specifications for the different classes of cars, safety regulations for circuits, the international calendar (which is arranged as far as possible so that important events in different countries do not clash), and, of course, the rules for the important championships.

ORGANISATION OF A CIRCUIT

During a motor race every part of a circuit is observed, and the observers are in telephone communication with race control headquarters, so that any incident can be acted on immediately.

Plan showing the pits, grandstand, and starting area of a race



The most dangerous parts of a circuit, of course, are the curved sections, where a driver has to fight the centrifugal force acting on his car (see page 630). This is where races are won and lost, where top drivers can corner that fraction faster than their rivals in cars of similar performance. Some circuits have banked corners, but these are most unpopular with drivers, who consider them to be unnecessarily dangerous.

Permanent installations at a race circuit include the timekeepers' tower, which must be in line with the start/finish line, and the pits – a line of compact service stations where cars can get 'first aid' during a race from highly trained mechanics. One pit is allotted to each competitor in most races, and this forms the headquarters for a driver's staff, which may include his own timekeeper, mechanics, and, if he is a member of a team, the team manager.

From time to time one of these people may display signals on a board to the driver, giving him details of the race – his position, the number of seconds he is in front of, or behind, the next car, instructions for stopping to refuel or change tyres (in a long race), and so on. A team of race mechanics can refuel a car, adjust its brakes, change the tyres, and have it back on the circuit in about half a minute.

SAFETY PRECAUTIONS

Whether a race circuit uses public roads, or is specially built, it has to conform to safety regulations. These specify a minimum width, and a minimum standard of protection for the public in the grandstands and enclosures. There must also be strict control in the paddock, or 'car park', which is usually situated close behind the pits, and is the area set aside for competitors and their servicing facilities before and after their races. In some cases the public are admitted to this area (usually at extra cost).

Motor racing is a sport which has had a spectacular growth in recent years, and is followed by many well-informed devotees.

HOW TO BECOME A RACING DRIVER

There is no short cut to the cockpit of a racing car, other than to pay for lessons at one of the reputable racing drivers' schools which operate at some of the British circuits. Although occasionally a top-line driver is 'spotted' at one of these schools, their main function is to teach the novice the first steps of track driving. In many cases they help to dampen a pupil's ambition to become a racing driver when he finds out that driving a racing car slowly is one thing, but driving it fast is very different from the most advanced form of driving on a road.

Someone with above-average ability, and a burning determination to progress further, may reach the top of the racing ladder, but the path to the top is certainly eased if one can boast some of the following:

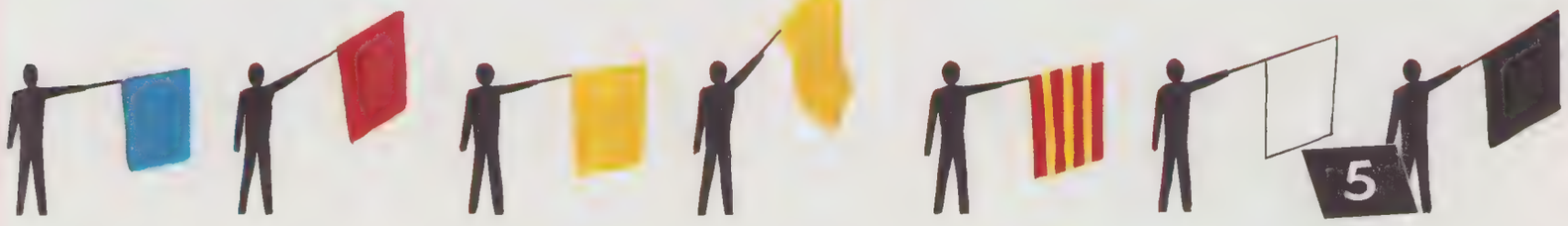
WEALTH Racing cars are expensive to buy, and equally costly to maintain (an engine 'blow-up' alone can cost hundreds of pounds). No one is likely to sponsor a racing driver in any way before he has proved himself.

NATURAL DRIVING ABILITY

TREMENDOUS ENTHUSIASM Anyone who is not an inveterate enthusiast for the sport will soon be discouraged by the many heartaches and pitfalls in motor racing.

AN ABILITY TO MAKE SACRIFICES Motor racing is a demanding sport, and frequently so time-consuming and tiring that it is impossible to lead a normal life.

A WILLINGNESS TO DEVELOP GRADUALLY Few drivers, however brilliant, reach the top straight away and stay alive. The most dangerous period is when a driver ceases to become a complete novice, and suddenly thinks it is all easy. That is when he is most likely to have a serious accident. If he passes successfully through this phase, he will probably become both faster and safer as he progresses. The best driver of all never stops learning, and improving his technique.



Blue flag stationary: you are being followed closely.

Red flag: the competitor signalled must stop immediately.

Yellow flag steady: obstruction ahead, go carefully.

Yellow flag waved: take extra care and be prepared to stop.

Red-and-yellow striped flag is shown to warn of oil on the track.

White: there is an ambulance or service vehicle on the course.

Black flag with a board carrying a competitor's number means he must stop.

MOVEMENT OF THE EARTH (part one)

THERE are about 12 known elements of movement which affect the Earth as a planet. Most of these take place so slowly that we only know about them from the measurement of small irregularities which occur in the two major movements. These two major movements, which can be observed without the aid of special instruments, are: first, the rotation of the Earth about its own axis; secondly, the revolution of the Earth about the Sun. The first takes one day; the second one year.

Apparent movements of heavenly bodies

Everyone knows that the Sun rises to the east and sets to the west. During the morning, the Sun rises in the sky until, at noon, it is at the highest point that it will reach on that day of the year. At this time the Sun will lie due south of someone looking at it in the northern hemisphere. After noon, the Sun appears to move downwards towards the western horizon until it eventually sets. If we also look at the sky at different times during a clear night, we see that the same pattern of events affects the stars. In the part of the sky where we saw the Sun in daytime, we can follow the passage of the stars as they rise above the eastern horizon, pass through their highest point, and then descend towards the western horizon. The stars placed high in the northern part of the sky do not set, but appear to move slowly around a point which is close to the Pole Star (Polaris), and which lies immediately above the North Pole.

Unless one lives inside the Arctic Circle it is impossible to follow the entire movement of the stars, because some of it takes place during the daytime, when the stars cannot be seen. A person living to the north of the Arctic Circle, however, can follow the passage of the Sun right round the sky in summer, during the period when it does not set, or watch the whole movement of the stars when it is dark all day during winter (see page 1134).

The movement of the stars will always appear to be a westward rotation about the Earth. In fact, it is the rotation of the Earth in relation to the other heavenly bodies that gives this impression. People on the Earth cannot be aware of its movement unless they watch the movement of objects which are in no way connected to the Earth. Just as a passenger in a train can tell that the train is moving forwards because through the carriage window he can see the countryside slipping backwards, so we can tell that the Earth is rotating eastwards because of the apparent westward movement of the stars.

The Celestial Sphere

In order to study the movements of the Earth, we have to choose certain points, or lines, from which we can take measurements. There is no single fixed reference point in space which can serve for all our measurements. It is well known that the members of the Solar System (see page 24) lie much closer to the Earth than any of the stars, and we know also that the visible stars lie at different distances from the Earth. However, let us assume that all these heavenly bodies lie at the same distance from the Earth, since this is how they appear to someone standing on the Earth's surface. If we make this assumption, we have to imagine that all the heavenly bodies lie on the surface of a Celestial Sphere, which has its centre at the same point as the centre of the Earth, but which has an infinitely larger radius.

The night sky as it is seen by an observer looking north shortly after sunset in early summer

The idea of the Celestial Sphere allows us to locate all the heavenly bodies in rather the same sort of way as we locate places on the Earth's surface with the help of latitude and longitude. Within the Celestial Sphere we may define certain points and lines which correspond to points and lines on the Earth. Thus there are two *celestial poles* which correspond to the two geographical poles (the North and South Poles), and the night sky appears to rotate about these two points. Above the Earth's equator is a corresponding line called the *celestial equator* or *equinoctial*.

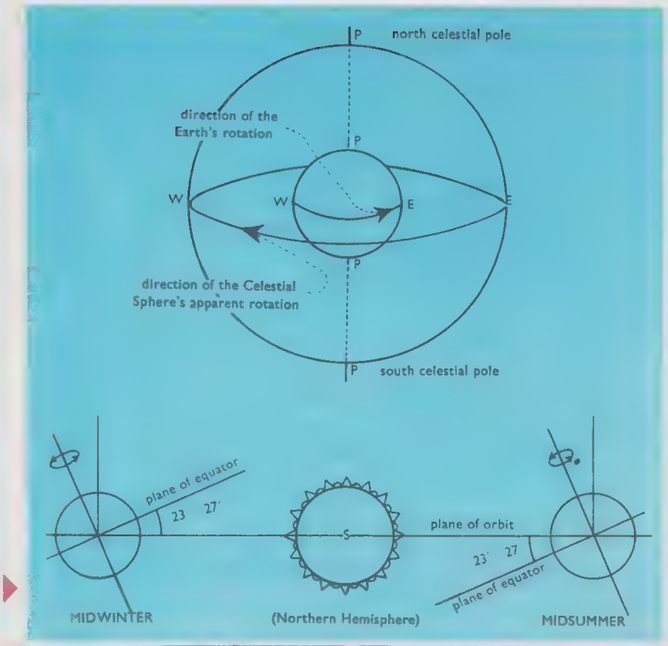
We measure the latitude of a point on Earth by means of the angle made at the Earth's centre between the lines to the equator and to the point (see page 48). In the same way, we can measure the 'latitude' of a star by the angle made at the centre of the Celestial Sphere between lines to the equinoctial and to the star itself. This angle is called the *declination* of the star. The angle which corresponds to longitude on Earth is measured between the meridian which passes through the star and another meridian which has been chosen as the starting point for such measurements. On the Earth we use the meridian through Greenwich as the starting point or *prime meridian*; on the Celestial Sphere we use the meridian which passes through the *First Point of Aries*.

The ecliptic and Signs of the Zodiac

The Earth's axis of rotation is defined by the two geographical poles which we can regard as two geometrical points about which the Earth rotates once in every 24 hours. The Earth also revolves about the Sun, in an orbit which has the form of an ellipse (this movement will be described in a later article). The axis of the Earth's rotation is at an angle to a line joining the centre of the Earth to that of the Sun, or, in astronomical terms, the *plane* of the equator is *inclined* to the plane of the Earth's orbit. The angle of inclination is about 23° 27′.

Because the celestial poles correspond to the geographical poles, the Celestial Sphere, too, is at an angle to the plane of the orbit of the Earth round the Sun. During the course of one year, the Sun appears to follow a path round the Celestial Sphere which is also inclined to the celestial equator by an angle of 23° 27′. This path represents a great circle on the Celestial Sphere, called the *ecliptic*.

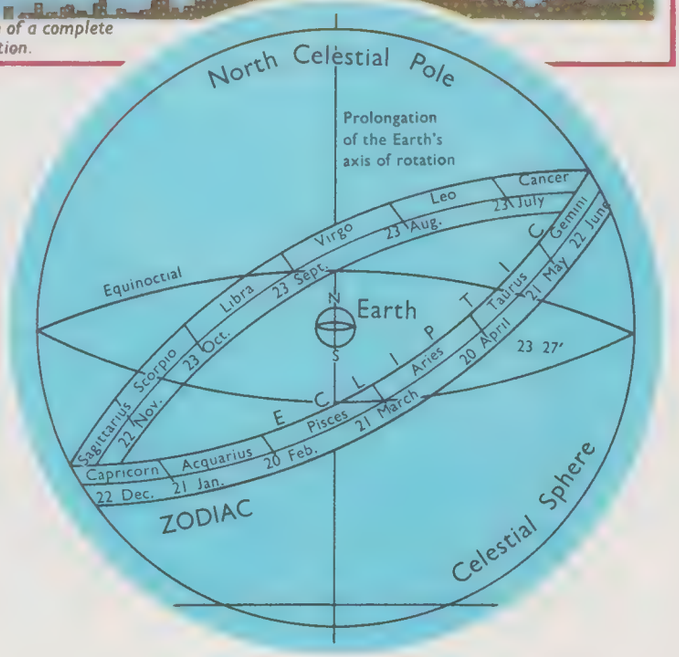
The belt of the heavens which lies within 8° of the ecliptic is known as the *Zodiac*, and the constellations of stars through which the Sun appears to pass during the year were divided by ancient astronomers



Above: diagram showing the true movement of the Earth and the apparent movement of the Celestial Sphere; below: the inclination of the Earth's equatorial plane to the plane of its orbit round the sun

Two hours later the constellations appear to have turned through 1/12th of a complete rotation. Polaris, the Pole Star, is still in approximately the same position.

into the Signs of the Zodiac. For the purposes of astronomy only two points on the ecliptic are of special importance. These are the points where the ecliptic crosses the celestial equator at the times of the Vernal Equinox (21st March) and Autumnal Equinox (23rd September), when the Sun is vertically overhead at noon on the equator and the period between sunrise and sunset is 12 hours. In terms of the Signs of the Zodiac these points correspond to the *First Point of Aries* and *First Point of Libra* respectively. The former takes its name from the constellation Aries (the Ram) through which the Sun appeared to pass when ancient astronomers plotted its path. However, the actual point of intersection of the ecliptic and celestial equator is moving very slowly backwards along the ecliptic, so that the First Point of Aries (the point of intersection) no longer coincides with the constellation Aries. The 'longitude' of a star can be measured from the celestial meridian through the First Point of Aries.



The Celestial Sphere, showing the celestial equator or equinoctial, and the Sun's apparent path, the ecliptic

Marine Square, Port of Spain, Trinidad

TRINIDAD AND TOBAGO

THE state of Trinidad and Tobago became a member of the British Commonwealth in 1962. The new state has a flag depicting a black diagonal bordered with white on a red ground, and a new coat of arms flanked by hummingbirds. The coat of arms bears the motto: '*Together we aspire; together we achieve*', which is, as the Minister for Home Affairs said in the speech he gave on Independence Day, 31st August 1962, '*so much in accord with the purpose and spirit of this new nation*'. For many different peoples, each with their own customs, have settled here, and all are working together to build the prosperity of this newest Commonwealth country.

Trinidad is the farthest south of the West Indian islands, and the second largest; it is 50 miles long and 37 miles broad. Tobago is an island 26 miles long and only 7½ miles broad; it is a single mountain mass, rising in the centre to a height of 1,890 feet, and covered with dense forest. The total population of the two islands numbers about 850,000.

Port of Spain, the capital of Trinidad, lies on the shores of the Gulf of Paria, and it is from this port that most of Trinidad's exports are shipped. Other important towns are San Fernando, Arima, and Scarborough, which is the capital of Tobago.

Agriculture and industry

Unlike some of the West Indian islands, Trinidad and Tobago have always been prosperous, because of the variety of their natural resources. They have never had to depend entirely on one industry. Oil was discovered in Trinidad early in the 20th century, and now forms one of her most important exports. The soil of both the islands is very rich and well adapted to the growth of agricultural produce, especially sugar and cocoa. Coffee, molasses, rum, timber, rubber, and asphalt are also exported.

Steel-drum players during Carnival

Asphalt is obtained from Trinidad's famous Pitch Lake, which came into being millions of years ago when large quantities of certain petroleums seeped into a mud volcano, and kept churning in the mud until the petroleum was converted into asphalt.

The earliest record of Pitch Lake comes from the diary of Sir Walter Raleigh, who reached Trinidad in 1595. He used asphalt from Trinidad to caulk his ships, and he wrote that he found it to be '*most excellent good*'. The asphalt is still used for this purpose, for surfacing highways, and for the protection of buildings from damp.

Early history

Trinidad was first discovered by Christopher Columbus on his third voyage of exploration in 1498. Near the mouth of the Moruga River Columbus saw three hills in the distance, and taking this to be an omen, he named the island *La Trinidad*, which means in Spanish 'the Trinity'. The Spanish did not make any permanent settlement on the island until 1584, when the town of San José de Oruña was founded. Spanish domination of the island was often threatened; the English realised the strategic importance of this island situated at the crossroads of the Caribbean, and Sir Walter Raleigh sacked San José in 1595. The French and Dutch also attacked the island on several occasions. Eventually it was captured by the British in 1797, and was ceded to Britain in the Treaty of Amiens in 1802.

The Dutch, British, and French struggled for possession of Tobago for three centuries, and it changed hands several times, but Britain finally gained it in 1803.

Carnival and calypsos

The rich farmland which guaranteed Trinidad's early prosperity attracted settlers from all over the world, including East Indians, Chinese, African negroes, and Europeans.

The chief festival of the islands is Carnival, which takes place on the Monday and Tuesday before Ash Wednesday. A traditional feature of Carnival is the calypsos or carnival songs which are composed and sung during the carnival season. The calypso singers are the chroniclers of Trinidad; their songs record significant events and their way of life. They are accompanied by steel bands. The 'steel drums' on which the music is played are not really drums at all, but tuned gongs made from the tops of steel barrels; they have replaced the bamboo drums which were brought to the islands by Africans, who came to work on the plantations.

COMMENT

CLOUD OVER ENGLAND

THE field is cleared; the bodies are removed; and the sticks and stones gathered up. We are left to take stock of the awful situation; namely that here in England there has been a slaughter of civilians more akin to the bloody years of the French Revolution.

Four years ago, in 1815, it seemed that a cloud had been lifted from Europe and that men and women could hold their heads high in a free world. The tyranny of Napoleon had been overthrown. Now, once more, there is a cloud of uncertainty, of repression and police violence – but today it hangs over England, not France.

Since the war, the condition of the people has been deteriorating. Prices have risen and wages fallen. Trade has stagnated and unemployment figures have reached new heights. Working conditions are appalling. The price of bread is kept high by the Corn Laws, and women and children are being worked 15 and 16 hours a day.

PARLIAMENT MUST BE REFORMED

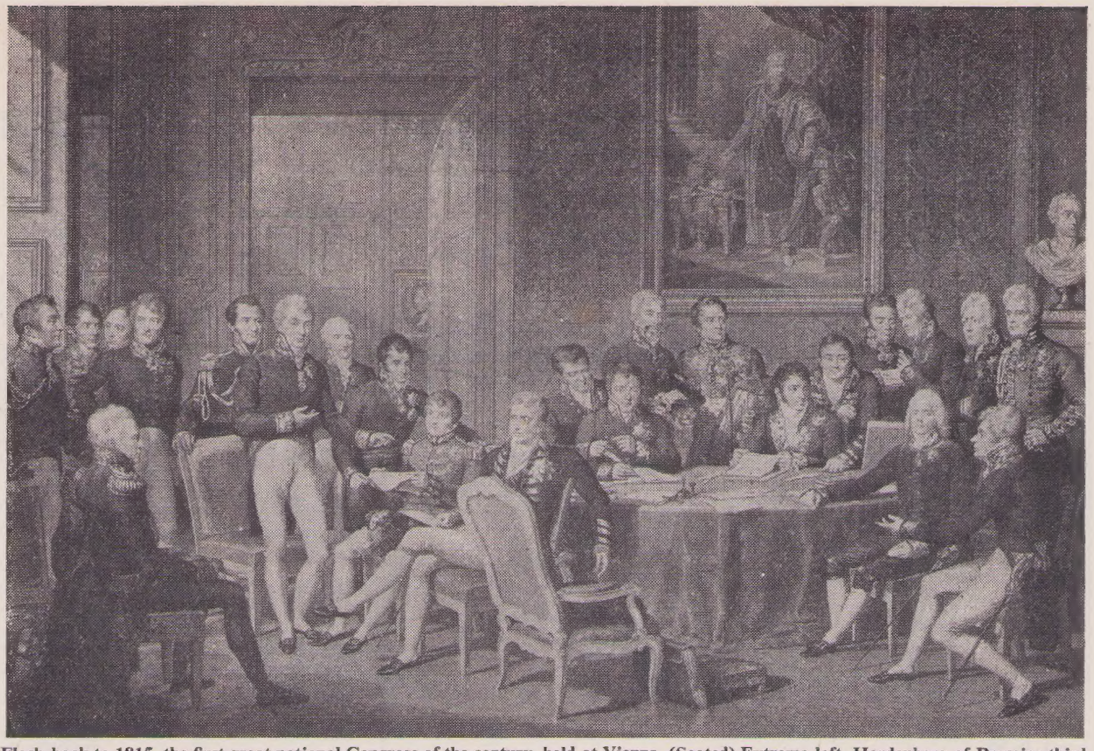
THE Radicals have fixed their sights on one main remedy for all these ills: Parliamentary reform. Industrialisation has meant the rapid development of towns such as Manchester, Leeds, Birmingham, Sheffield, Wolverhampton, Bolton and Bradford.

Not one of these towns returns a member of Parliament. Public opinion is relying on the iniquity of this situation as contrasted with tiny villages like Old Sarum, Gatton, Beeralston and Tregony, which return two members each. In Gatton there are seven voters; in Tavistock 10.

But the grievances of the people are economic. Unless the Government wants a civil war on its hands, or unless it wants actually to be forced to alter the structure of Parliament, it must do something to ease the distress in the new overcrowded industrial towns.

WHO ARE THE RADICALS?

THE Radicals are mainly members of the working classes who are campaigning against the poverty and distress which is common to so many sections of this country. At 'Peterloo' many of the crowd were handloom weavers whose weekly wages amount to between 6*s* and 12*s*. Their remedy is reform of Parliament. They want a vote for every man, annually elected Parliaments, and they want their own representatives to sit in Parliament.



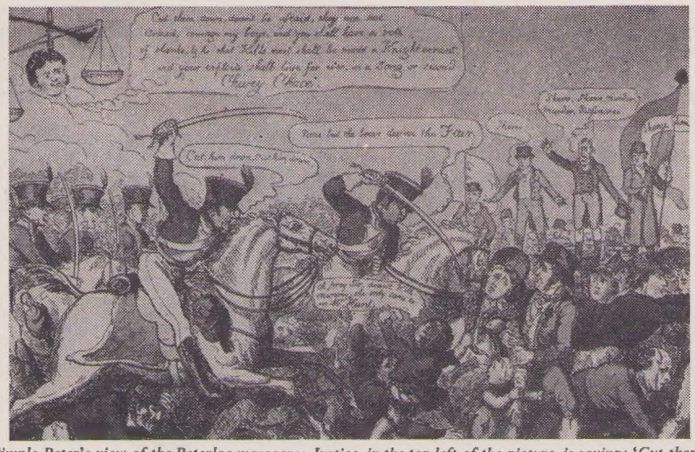
Flash-back to 1815, the first great national Congress of the century, held at Vienna. (Seated) Extreme left, Hardenberg of Prussia; third from left, Castlereagh of Britain; second from right, Talleyrand of France. (Standing) Sixth from left, Metternich of Austria; eighth from left, Count Nesselrode of Russia.

BIG FIVE TO MEET?

AN ugly situation is developing in Spain, where elements hostile to King Ferdinand are thought to be plotting his overthrow. In this event a further Congress would certainly be called to discuss the matter.

Since the Congress of Vienna in 1815 made provision for further meetings of the Great Powers, there has been one such Congress, that at Aix-la-Chapelle last year. This Congress admitted France to the 'Family of Nations' by the establishment of the Quintuple Alliance to exist alongside the former Quadruple Alliance which excluded her. Diplomats are anticipating difficulties in the event of an Iberian revolution, for the Austrian Chancellor, Metternich, Alexander of Russia and Hardenberg of Prussia would support intervention to crush any revolt against a lawful sovereign. But Castlereagh, the British Foreign Minister, is known to deplore interference in the internal affairs of these countries. If the expected situation develops, the attitude of France could prove decisive.

Simple Peter looks around



Simple Peter's view of the Peterloo massacre: Justice, in the top left of the picture, is saying: 'Cut them down! Don't be afraid, they are not armed. Courage, my boys, and you shall have a vote of thanks, and he that kills most shall be made a knight errant, and your exploits shall live for ever. . . .' The little boy, right centre, is crying: 'Oh pray, sir, don't kill Mammy; she only came to see Mr Hunt.'

THE EARL OF SALMON RIVERS?

I WOULD have thought the Prime Minister might have had a special concern for the depressed areas of Lancashire. After all, he is the Earl of Liverpool. But of course the days are long since past when titles brought with them administrative responsibilities.

If Earls were forced to live in their Earldoms, I can imagine our Prime Minister endeavouring to change his title to that of the Earl of Pall Mall, or, perhaps, the Earl of Salmon Rivers.

TALE OF TWO BRIDGES

ONE of our more peculiar laws has been brought to my attention. John Davis, a bricklayer, was arrested for chalking 'No Corn Laws' on Westminster Bridge, and is in custody while magistrates deliberate on his sentence. His crime is said to have been 'damaging Westminster Bridge'! Unfortunately for him it is an offence which carries the death penalty, and if it is enforced he will suffer under one of the most absurd laws in the statute book. If this poor man had known this he would surely have moved a little farther down the river to write his harmless, humble slogan on, say, London Bridge! Then no doubt he would only be facing the prospect of half a lifetime in prison for 'incitement to riot', or something equally preposterous.

SATANIC MILLS

EVERY day new factories spring up; smoke belches forth; and mill wheels revolve. Every day fresh products stream from the factories, and manufacturers wax fat and rich. This is progress.

But perhaps not everybody will condemn the nostalgic deliriums of a stick-in-the-mud columnist who wonders whether the crowding of an ever-increasing population into ill-lit, badly constructed and overpopulated buildings, and the transforming of the Yorkshire and Lancashire landscapes into a nightmare of cotton mills are really an advance.

Have we forgotten that William Blake once called England a 'green and pleasant land'? My impression of the new towns – Liverpool, Birmingham, and Manchester – is that they are black and distinctly unpleasant. In fact, Blake's expression 'dark Satanic mills' is much more realistic.

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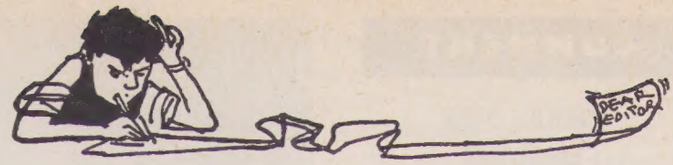


Red Indian Riders

DEAR EDITOR—We know that the Red Indians were very good horsemen, but they did not always have horses. They had seen horses as early as 1540, but did not catch and ride them until the early 18th century, 250 years after the Spanish introduced horses into the Western Hemisphere.

By watching the Spanish *vaqueros* the Indians learned how to capture the horses by chasing them into box canyons and lassoing them with ropes made of buffalo hide.

M. Fretwell (age 14),
35 Union Street,
Sutton-in-Ashfield, Notts.

There are articles about the Red Indians in Knowledge *Nos. 36 and 37. —Editor.*

Surfeit of Salt

DEAR EDITOR—A friend of mine bought a packet of crisps at our school tuckshop, and found 18 packets of salt inside. I am sure this must be a record.

Richard Kasher (age 12),
22 Gardner Avenue,
Willington,
Crook, Co. Durham.

A Prophecy Fulfilled

DEAR EDITOR—In Minster Abbey, Sheppey, is the tomb of Sir Robert de Shurland, Lord of Shurland and Minster in the reign of Edward I. Sir Robert, who was Lord Warden of the Cinque Ports and Baron of Sheppey, was knighted for gallantry at the siege of Caerlaverock.

Behind Sir Robert's effigy on the tomb is the head of a horse, Sir Robert's faithful charger Grey Dolphin. There is a curious story about this horse.

Sir Robert once killed a monk, and decided to ask the king for mercy. However, the king's ship was prevented from landing by a storm so Sir Robert mounted Grey Dolphin and swam out to the ship. The king pardoned Sir Robert, who then returned to the shore on Grey Dolphin's back. When they reached the shore, they met an old woman who prophesied that Grey Dolphin would, within a year, be the cause of Sir Robert's death. The knight then killed his horse, and buried it on the shore.

Almost a year later, Sir Robert was walking along the same shore when he tripped over an object half buried in the sand and received a deep cut. He turned to find the old woman beside him, and she said that he had cut himself on Grey Dolphin's skull. Sir Robert returned to Shurland Hall, but his cut did not heal, poisoning set in, and he died shortly afterwards.

Julie Coe,
83 Alma Road,
Sheerness, Kent.

Polish Parks

DEAR EDITOR—My father lived in pre-war Lodz and was surprised to read in *Knowledge* No. 109 that there were no parks in that city. He told me that then there were at least five public parks, the largest of which was that of Prince Poniatowski and one square mile in area. It contained five tennis courts, two football pitches, an artificial lake, a large deer enclosure and ornamental gardens. Two of the other parks also contained football pitches.

Christine Slomkowska,
11 Bentley Street,
Melton Mowbray.

Thank you for pointing this out.—Editor.

Can you answer these?

1. Who was Prime Minister at the time of 'Peterloo'?
2. Who was the Home Secretary at the time of 'Peterloo'?
3. In which town did 'Peterloo' take place?
4. In which year did 'Peterloo' take place?
5. Name at least two of the slogans that appeared on the banners at 'Peterloo'.
6. How many people were killed at 'Peterloo'?
7. Who was the acknowledged Radical leader of the time?
8. About how many offences carried the death penalty at this time?
9. When was the Second Factory Act passed?
10. Under this Act, how many hours was a child between nine and 16 allowed to work?
11. How many Members of Parliament did Manchester return?
12. When was the 'march' of the 'Blanketeers'?

ANSWERS

1. *Lord Liverpool.*
2. *Lord Sidmouth.*
3. *Manchester.*
4. *1819.*
5. *No Corn Laws; Annual Parliaments; No Taxation Without Representation.*
6. *Eleven.*
7. *Henry Hunt.*
8. *About 200.*
9. *1819.*
10. *Up to 12 hours a day.*
11. *None.*
12. *10th March 1817.*

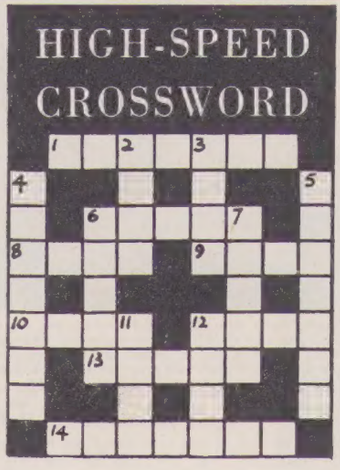
BRAIN ? BOX

1. A month after the beginning of the football season the Rovers' record read: Played 4; Won 2; Drawn 1; Lost 1; Goals for 7; against 2.
   In one of their victories the Rovers' score was the same as in their defeat. What were the scores of these four matches?
2. Herbert's hobby has for many years been making in his large garden a model of the village in which he lives. It is now, he says, as complete as it ever will be. Every building and feature of the village has been reproduced to scale by wonderful craftsmanship. Nothing has been overlooked.
   Yet there is one thing that has beaten Herbert and which, he tells me, makes it impossible for him ever to finish an outdoor model of his village. What is it?
3. MAY is 349 and MARCH plus APRIL make 80,339. For what numerical values do the latter two months stand? (C is greater than I and H than L; O is not used.)

ANSWERS

1. Rovers 1, Opponents 0; Rovers 5, Opponents 0; Rovers 0, Opponents 0; Rovers 1, Opponents 2.
2. In the model village Herbert has reproduced his own house and garden. In the garden, therefore, he must reproduce a model of the actual model he has made there, and within this model another, and so on, ad infinitum. Eventually the model within the models becomes so small that it is impossible to continue a process which theoretically would never end.
3. MARCH, 34,187; APRIL, 46,152.

HIGH-SPEED CROSSWORD



Clues Across

1. Always found on the tea-table (7).
6. If a 'stare' is broken, these may be formed (5).
8. 'A shy, pale person' provides both the word and clue (4).
9. As veal is to calf, so is —— to bull (4).
10. Length × breadth gives it (4).
12. What you find in Piccadilly Circus, standing on his head and making it ——? (4).
13. You write it at school (5).
14. Citrus fruits (7).

Clues Down

2. We: us: ——: them (4).
3. Ian and two others desert the barbarian and this is the point (4).
4. On TV it 'comes from the North', yet you find it on the map of Spain (7).
5. Rugby team (7).
6. The —— Musketeers (5).
7. Native Indian soldier (5).
11. Large continent (4).
12. Sing, ——, sung (4).

Solution next week

SOLUTION TO LAST WEEK'S CROSSWORD

ACROSS: 1, Science; 6, Unit; 8, Atom; 9, Newts; 11, Met; 12, Spear; 14, Duet; 15, Role; 16, English.

DOWN: 2, Cain; 3, Cats; 4, Outside; 5, Smother; 7, Tempt; 8, Attar; 10, Wee; 12, Seen; 13, Rods.

MORE JOKES

A lady entered a dress shop and said to the assistant: 'I would like to try that dress on in the window.' Very taken aback, the assistant replied: 'I am sorry, madam, but I must ask you to use the dressing-room.'

E. J. Micallef,
Poinsette,
Prince Andrew Avenue,
Msida, Malta G.C.

Arriving back from a walk and finding the soup gone, Father Bear said: 'Somebody has eaten my soup.' Mother Bear said: 'Somebody has eaten my soup,' and Baby Bear said: 'Somebody has eaten my soup.' Grandma Bear said: 'You bears are jumping to conclusions. I haven't served it yet.'

Alan Camp,
81 Grant Street,
North Cottesloe,
Western Australia.

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own work and are taught to accept responsibility.

In an infant classroom the children have a nature table full of a variety of things: nuts, leaves, twigs, and pictures of animals, many of which they bring to school themselves. They grow bulbs here, and are taught to understand the various parts of plants they look at. They learn how to use money in the classroom shop, and look at the books in their library corner. The pupils particularly enjoy using the climbing frame and other special apparatus, and this helps to give them confidence and to develop their bodies. They paint pictures, dress up, sing, and model with clay, under the careful attention of their teachers. Most children love their early years of education and enjoy going to school.

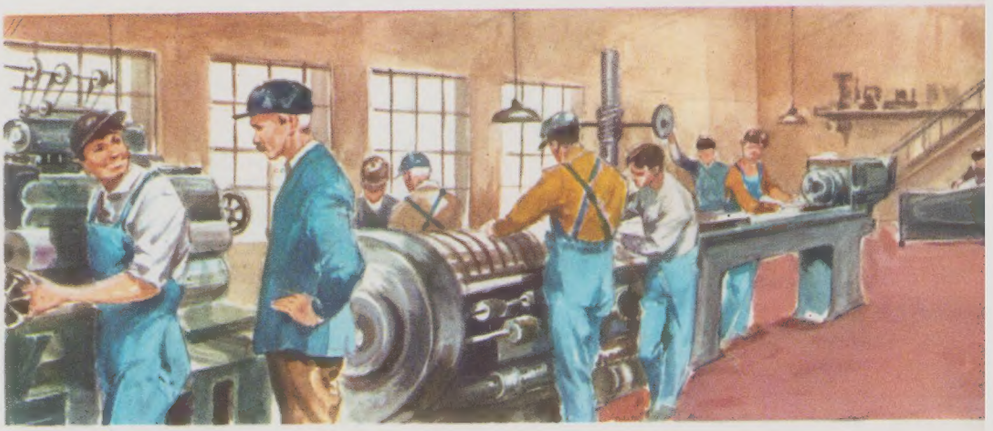
Junior schools

When children leave the infant schools, they go to junior schools until they are about 11 years of age.

Measuring each other and things in the classroom makes it easier for young children to learn how to calculate

Most of them can already read, write, and do simple sums, and the teachers in the junior schools build upon this foundation.

Geography and history are made lively and interesting by studying the school neighbourhood, by drawing maps, and by visiting nearby museums and buildings of historical interest. They may also visit local civic institutions, like town halls and fire stations, and go for walks in the countryside and visit farms. Teachers and educationists believe that children learn best when they take an active part like this in their lessons.



In a school workshop older pupils learn about machines and materials

The junior classroom often looks rather like a workshop, especially when the pupils are working in groups at a project which involves making models, and other practical work. Some of the pupils' work, such as pictures, maps, and time charts, is displayed on the walls.

Children learning about measurement measure their books, desks, and classrooms, and do calculations based on their findings. They learn to write, and to express their thoughts in words by describing everyday objects and happenings in essays. Among the other subjects which they are taught are music, art, and organised games.

Secondary education

Until children reach the age of 11 they have much the same sort of education, whether they go to State schools or private schools, and whether they learn quickly or find it difficult. But by the time they are 11, many children

Drawing, painting, and making models provide a background for history lessons

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In open-air schools for delicate children as many lessons as possible are held out of doors

have started to develop in one direction or another, and there are several different types of school to cater for their interests and abilities.

One of the main purposes of education is to fit us for the life we lead after we have left school. Some children want to become engineers, scientists, librarians, nurses, or teachers; they need to go to schools where academic subjects, including foreign languages, biology, and chemistry, as well as English, history, geography, and mathematics, are taught to a high standard. Others want a more technical education, so that they can learn subjects like mechanics (for boys) or shorthand and typing (for girls).

But some children have not shown any special ability, either for academic work or for technical subjects, by the time they are 11. There are many schools which provide them with a general education, in which both academic and technical subjects are taught, but not to such a high standard as in more specialised schools.

All children must stay at school until they are 15, and many of them stay longer and take national examinations, when they are 16 or 17. Technical colleges run day and evening classes for people who want to learn about subjects in which they are interested, or to qualify for particular jobs, and firms often encourage their younger employees to take time off to attend classes which will be useful in their work, and even pay the necessary small fee.

State schools are divided into the following types:

Grammar schools. Children who go to grammar schools are usually those who have shown a preference for academic subjects, although many grammar schools now have technical courses. They aim to send as many children as possible to universities.

Technical schools. Boys and girls who are interested in working with their hands and learning in a practical way can go to a technical school where trades are taught and a technological education is available.

Modern schools. Many children go to the modern schools. Here there is a wide variety of education. Modern languages can be learned, and workshops are provided for those who are skilful with their hands. Different methods and a variety of courses, both commercial and technical, are features of many of these schools.

Comprehensive schools. These schools combine all the advantages of the other secondary schools. They have well-equipped physics, chemistry, and biology laboratories, machine workshops for metal and woodwork, and also geography, history, and art departments. There are also English and foreign language departments, commercial and domestic courses – the whole field of secondary education is covered. Playing-fields and a gymnasium are provided for the physical development of the pupils.

There are, of course, many schools which are not controlled by the State. These include private schools, independent schools, preparatory schools, and public schools. They charge fees for educating the children, and many of them are *boarding* schools, at which pupils live during the term time. The education varies from school to school; most of them provide a good general education, while many of them also specialise in some branch of study.

Special schools

A modern civilised nation arranges for education for all its children. Some children are handicapped, either physically or mentally, and cannot go to the same sort of school as other children. Instead they go to special schools. These include schools for the deaf and blind, for delicate children (open-air schools), for emotionally disturbed or maladjusted children, and for the physically handicapped. There are also schools for children who are not as intelligent as the children who go to ordinary schools. Teachers who work in these schools have special training and the schools are specially equipped. Where it is necessary, nurses and doctors are always available.

Modern education uses every aid it can in teaching. Television, radio, films, record players, and tape recorders are a few of the modern inventions in daily use in schools, and form part of their normal equipment.